REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Official Action dated March 20, 2003.

Claims 1-50 and 52-105 are under consideration in this application. Claim 51 is being cancelled without prejudice or disclaimer. Claims 1, 2, 4, 5, 8, 14, 17, 19, 28, 36, 39 and 55 are being amended, as set forth above and in the attached marked-up presentation of the claim amendments, in order to more particularly define and distinctly claim applicants' invention. Applicants hereby submit that no new matter is being introduced into the application through the submission of this response.
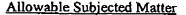
In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

Claims submitted via a Preliminary Amendment

Applicants respectfully contend that the claims 61-105 were submitted via a Preliminary Amendment filed on June 15, 2000 but not acknowledged in the outstanding Office Action. The Examiner is respectfully requested to give due reconsideration to claims 61-105, and to indicate the allowability of these claims. A copy of the Preliminary Amendment and the stamped postcard indicating the Office's receipt of the Preliminary Amendment are enclosed.

Formality Rejection

Claims 5, 14, 19, 21, 22, 28 and 29 were objected to for various informalities. As indicated, the claims have been amended to clarify the dependencies or as otherwise suggested by the Examiner. Accordingly, the withdrawal of the outstanding informality rejection is in order, and is therefore respectfully solicited.

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Allowable Subjected Matter

The Examiner indicated that claims 2, 4, 6, 7 and 10 would be allowable if rewritten in independent form and to overcome any outstanding claim objections. Claims 55-56 would be allowable if their dependencies were changed fromf claim 55 to 49. Claims 11-50, 52-54 and 57-61 are allowed.

Claims 2 and 4 are being amended in independent form, whereby their dependant claims 6, 7 and 10 also become allowable. Claim 55 is being amended to depend from claim 49, whereby its dependent claim 56 also becomes allowable. As all the above-mentioned allowable claims have been amended as suggested by the Examiner, they are now in condition for allowance.

Claim Rejections Pursuant to 35 U.S.C. §103

Claims 1 and 5 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,229,998 to Hamdy et al. (hereinafter "Hamdy"), and Claims 3, 8 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hamdy in view of U.S. Patent No. 5,260,968 to Gardner et al. (hereinafter "Gardner"). These rejections have been carefully considered, but are most respectfully traversed.

The system for detecting a signal according to the invention, as recited in claim 1, comprises: a receiver 10 for receiving a wideband signal to be processed; a sub-band conversion module 20 for converting the wideband signal into a plurality of sub-band signals to be processed; a channelizing module 30 for Fast Fourier Transform channelizing said plurality of sub-band signals into a respective plurality of complex spectral components; a processing module 40 for signal processing said plurality of complex spectral components, including a means for determining the presence of at least one signal of interest based on multiple time averaging analysis of said plurality of complex spectral components; and a high speed data router 70 as means for digitally routing respective plurality of module data between said modules.

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Applicants respectfully contend neither Hamdy nor Gardner teaches or suggests "a sub-band conversion module for converting the wideband signal into a plurality of sub-band signals to be processed."

Contrary to the Examiner's allegation that the element 1504 in Fig. 15 in Hamdy functions equivalent to the sub-band conversion module of the invention, Applicants respectfully contend that the complex sampler 1504, at most, functions similar to the ADC 210 in the sub-band conversion module of the invention for supplying digital complex in-phase and quadrature (I&Q) signals (page 17, lines 2-3) in that the complex sampler 1504 also utilizes complex sampling as described in col. 6 lines 37-46 to provide two (I and Q) sample streams (col. 8, lines 63-67) from one attenuated signal. Hamdy does not have a plurality of digital down converters (DDCs) 220, and its sampler 1504 does not provide a plurality of streams of digital samples and can not distribute the plurality of streams of digital samples to a plurality of DDCs it does not have. Hamdy's sampler 1504 only provides one stream of digital samples (col. 6, line 39; col. 9, line 31; col. 10, line 14) rather than a plurality of streams of digital samples to a plurality of DDCs of the sub-band conversion module of the invention for sub-band tuning (page 17, lines 3-5; Fig. 1a).

Subsequently, since Hamdy does not have a plurality of sub-band signals provided by its sampler 1504, Hamdy can not perform Fast Fourier Transform channelizing on a plurality of sub-band signals to provide a respective plurality of complex spectral components as does the channelizing module 30 of the invention. Such a deficiency is acknowledged by the Examiner on page 4, lines 13-16 of the outstanding office action. These deficiencies are the result of Hamdy's lack of a plurality of DDCs of the sub-band conversion module of the invention for sub-band tuning.

The term "sub-bands" is only mentioned in one context in Hamdy (col. 6, line 50). Only after (rather than "before") the FFT on the I and Q sample streams 212, many sub-bands or bins are generated (col. 6, lines 49-51; Fig. 16). On the other hand, the sub-band conversion module of the invention converts one wideband signal into a plurality of sub-band signals before the FFT processing. As such, Hamdy's sampler 1504 does not convert one wideband signal into a plurality of sub-band signals before the FFT processing as does the sub-band conversion module

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of the invention. Further, Hamdy's Fast Fourier Transform does not channelize a plurality of sub-band signals to provide a respective plurality of complex spectral components.

Gardner fails to compensate for the deficiencies of Hamdy in that Gardner does not teach ONE sampler (ADC 210) that distributes a plurality of streams of digital samples to a plurality of DDCs for sub-band tuning before FFT processing. Gardner was relied upon by the Examiner to teach (1) Fast Fourier Transform channelizing a plurality of sub-band signals to provide a respective plurality of complex spectral components; and (2) a data router port for routing the plurality of complex spectral components to the processing modules. At most, Gardner's FFT channelizes a plurality of spatially separable (rather than "sub-band") signals to provide a respective plurality of signals. In Fig. 3, Gardner illustrates uniformly spectrally overlapping signals with indeterminate Fast Fourier Transformation resolution. In Figure 9, FFT 180 is divided by Group 182 into uniform sets of FFT channels, wherein each Group output is reconstituted by IFF5 184 to produce a plurality of L*1 vector signals (col. 11, line 54). Gardner uses a fixed grouping (col. 15, line 50) wherein "Grouping module 182 groups the bands into 64 kHz sub bands prior to a 64-point inverse Fast Fourier Transform [IFFT]. The purpose of this FFT is to apply a *fixed transformation* (col. 15, lines 53-57) "to split a spectral band having a width of 1024 kHz into several overlapping bands having a width of 64 KHz whose centers are separated by 1 KHz."

In other words, although Gardner does divide the spectrum with an FFT, it does not derive hyperspectral channels wherein only ONE signal of arbitrary bandwidth resides.

Applicants will respectfully point out to the Examiner that any reliance upon the "common knowledge and common sense" of one skilled in the art for the allegedly "inherent" teachings and any motivation for combining the teachings of Hamdy and Gardner has to fulfill the agency's obligation to cite the positive teachings in the references to support its conclusions on the record to allow accountability.

> To establish a *prima facie* case of obviousness, the Board must, *inter alia*, show *"some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references." In re Fine, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). "The motivation, suggestion or teaching may come explicitly from*

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statements in the prior art, the knowledge of one of ordinary skill in the art, or, in
some cases the nature of the problem to be solved." Kotzab, 217 F.3d at 1370, 55
USPQ2d at 1317. .... Recently, in In re Lee, 277 F.3d 1338, 61 USPQ2d 1430 (Fed.
Cir. 2002), we held that the Board's reliance on "common knowledge and common
sense" did not fulfill the agency's obligation to cite references to support its
conclusions. Id. at 1344, 61 USPQ2d at 1434. Instead, the Board must document its
reasoning on the record to allow accountability. Id. at 1345, 61 USPQ2d at 1435.

See In re Thrift, 298 F.3d 1357.

Such an obligation to provide specific teaching(s) also applies to any existing or future obviousness rejections.

Even if, arguendo, a person of ordinary skill were motivated to combine the teachings in Hamdy and Gardner, such combined teachings would still fall short in fully meeting the Applicants' claimed invention as set forth in claim 1 since, as discussed, there is no teaching of "a sub-band conversion module for converting the wideband signal into a plurality of sub-band signals to be processed" in either Hamdy or Gardner.

The invention, as now recited in claim 8, is also directed to a system for detecting a signal, comprising: a receiver for receiving a wideband signal to be processed; a sub-band conversion module for converting the wideband signal into a plurality of sub-band signals to be processed; a channelizing module for Fast Fourier Transform channelizing said plurality of sub-band signals into a respective plurality of complex spectral components; a processing module for signal processing said plurality of complex spectral components, including a means for determining the presence of at least one signal of interest based on multiple time averaging analysis of said plurality of complex spectral components; and a high speed data router as means for digitally routing respective plurality of module data between said modules. The channelizing module includes a plurality of Fast Fourier Transform (FFT) channelizers operatively connected to receive corresponding ones of said plurality of sub-band signals and thereby generate a corresponding plurality of the complex spectral components, and a data router port for outputting said plurality of complex spectral components to said processing module. In particular, each of said plurality of

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Fast Fourier Transform (FFT) channelizers includes <u>means for hyperchannelizing</u> the corresponding one of said plurality of sub-band signals <u>into hyperchannelized signals each with a bandwidth at least 30% narrower than a bandwidth of said at least one signal of interest</u> in generating said corresponding complex spectral components in order *"[t]o hyperchannelize radio or acoustical spectrum into spectral cells <u>narrower</u> than the signal structure of interest [so as to] detect, synthesize, and recognize arbitrary signal activity, and determine signal direction by phase determination of angle of arrival or time difference of arrival."* (page 1, lines 18-21). *"It is an object of the present invention to intercept a wideband RF signal environment* [which bandwidth is wideband (e.g. 20-50 MHz bandwidth)], *sub-band and channelize said signal into a plurality of complex spectral segments and select therefrom a plurality of narrowband signals in a flexible manner by combining spectral segments in time and frequency for improvement in signal detection and demodulation of arbitrary narrowband modulation types and bandwidths"* (page 5, lines 5-9). Also, *"while the term "wideband" is not limited to any particular spectral range, it is to be understood to imply a spectral coverage of at least an order of magnitude larger that the bandwidth of the majority of signals in that portion of the spectrum. Narrowband, on the other hand, implies only a portion of the spectrum, for example, the width of an individual channel (e.g. 3 kHz in HF, 30 kHz in VHF or UHF)"* (page 16, lines 11-16).

In the RF signal bandwidth, the signals of interest are "a plurality of narrowband signals", typically with 1 kHz to 25 kHz bandwidth. The smallest bandwidth of interest, i.e., 1 kHz, was chosen as the **floor** for hyperchannelization, which is <u>30%</u> the bandwidth of expected signals, as indicated in the concurrently filed Declaration Of Inventor(s) Under 37 C.F.R.§1.132. For example, *"an 8k FFT results in a spectral data bandwidth of approximately 330 Hz that is <u>10%</u> the bandwidth of expected signals. The object of the FFT device 310 is to channelize time domain data into complex spectral components that are much narrower than any signal of interest bandwidth. This is referred to as hyperchannelization"* (page 20, lines 15-19).

After the hyper-channelization, the spectral segments are combined in time and frequency to generate/reconstruct the signal of interest. *"[I]t will be readily appreciated that improvements are needed to... provide improved signal detection and direction finding of signals whose bandwidth do not match a fixed channel bandwidth"* (page 4, line 26). *"It is to be noted that for most communication purposes, the bandwidth of the receiving digital filter matches the bandwidth*

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of the wideband FFT channelizer. Whereas for this present invention, the software digital filters 417 may act upon a signal that is either wider than or narrower than a single respective wideband FFT channelizer segment (page 27, lines 22-26)."

As admitted by the Examiner, the channeling module 1606 of Hamdy does not teach using a plurality of FFT channelizers operatively connected to receiver corresponding ones of said subband signal so as to generate a corresponding plurality of complex spectral components. On the other hand, Gardner merely describes the maximum number of users (L) that can be accommodated as specified in his equation (8) using a reuse factor r, a total system bandwidth B_t, a signal bandwidth (B_c) and a signal separation f_{sep} (Col. 11, Lines 27-31), but fails to quantify the frequency reuse factor (r), nor FFT channelization bandwidth.

Gardner and the relevant prior art focus on matching the bandwidths of the FFT channelized signals with a **communication** signal of interest so as to, for example, look for a base station. On the other hand, the invention recited in claim 8 hyperchannelizes spectral data bandwidth into approximately 30% the bandwidth of an arbitrary signal or a signal of interest for intercepting signals. For normal communications, matched bandwidth between system and signal is a goal. For Gardner, the relevant use of FFT is uniform channel recombination for signal grouping. For this invention, since the signal bandwidth is not known, a priori, an approach is taken to use FFT channelization smaller than the smallest bandwidth signal in the spectrum and reconstitute a bandwidth by synthesizing hyperchannels back together either incoherently for signal detection means or coherently for signal demodulation and direction finding means.

For separating the signals form K number of users, the channelization scheme in Gardner requires M number of antenna elements where $M>K=(B_c/f_{sep}-1)$. Taking $B_c = 32$ KHz and $/f_{sep}= 1$ KHz as an example, "at least 63 antenna elements are needed to separate the signals of all users" (Col. 11, Lines 31-38). On the contrary, the FFT hyperchannelization according to the invention requires at least one antenna element. The illustration from page 33, lines 27 to page 34, line 21 of the specification concerns the performance of the signal demodulation/recognition processor of the present invention in connection with the use of a signal detection device.

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In addition, Gardner's channelization and processing is only applicable to BPSK signals (Col. 11, Lines 1-3), rather than any arbitrary narrowband signal such to be detected and recombine from some arbitrary subset of adjacent hyperchannels as in the invention.

Applicants contend that the cited references or their combinations fail to teach or disclose each and every feature of the present invention as disclosed in independent claims 1 and 8. As such, the present invention as now claimed is distinguishable and thereby allowable over the rejections raised in the Office Action. The withdrawal of the outstanding rejections under 35 U.S.C. §103 is in order, and is respectfully solicited.

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art reference upon which the rejections in the Office Action rely, Applicants respectfully contend that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and phone number indicated below.

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Marked-up Version of Amended Claims

1.   A system for detecting a signal, comprising:

a receiver for receiving a wideband signal to be processed;

a sub-band conversion module for converting the wideband signal into a plurality of sub-band signals to be processed;

a channelizing module for Fast Fourier Transform channelizing said plurality of sub-band signals into a respective plurality of complex spectral components; [and]

a processing module for signal processing said plurality of complex spectral components, including a means for determining the presence of at least one signal of interest based on multiple time averaging analysis of said plurality of complex spectral components[.]; and

a high speed data router as means for digitally routing respective plurality of module data between said modules.

2.   A system [according to claim 1,]for detecting a signal, comprising:

a receiver for receiving a wideband signal to be processed;

a sub-band conversion module for converting the wideband signal into a plurality of sub-band signals to be processed;

a channelizing module for Fast Fourier Transform channelizing said plurality of sub-band signals into a respective plurality of complex spectral components;

a processing module for signal processing said plurality of complex spectral components, including a means for determining the presence of at least one signal of interest based on multiple time averaging analysis of said plurality of complex spectral components; and

a high speed data router as means for digitally routing respective plurality of module data between said modules,

wherein said sub-band conversion module includes an analog-to-digital converter (ADC) for converting the wideband signal from the receiver, a plurality of digital down converters operatively connected to said ADC so as to each generate a sub-band of the

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digitally converted wideband signal from the ADC, and a data router for outputting the plurality of sub-band signals to said channelizing module.

4.   A system [according to claim 1,] for detecting a signal, comprising:
        a receiver for receiving a wideband signal to be processed;
        a sub-band conversion module for converting the wideband signal into a plurality of sub-band signals to be processed;
        a channelizing module for Fast Fourier Transform channelizing said plurality of sub-band signals into a respective plurality of complex spectral components;
        a processing module for signal processing said plurality of complex spectral components, including a means for determining the presence of at least one signal of interest based on multiple time averaging analysis of said plurality of complex spectral components; and
        a high speed data router as means for digitally routing respective plurality of module data between said modules,
        wherein said processing module includes a plurality of channel processors operatively connected to said data router so as to receive corresponding ones of said plurality of complex spectral components, each of said channel processors being formed so as to determine the presence of signal activity and perform demodulation of at least one signal of interest within the corresponding complex spectral component thereof.

5.   A system according to claim [1]3, wherein said data from sub-band data stream and FFT channelizers are operatively connected to subsequent processing modules by the high speed data router for connecting said plurality of complex data streams to said processing modules.

8.   A system [according to claim 3,] for detecting a signal, comprising:
        a receiver for receiving a wideband signal to be processed;
        a sub-band conversion module for converting the wideband signal into a plurality of sub-band signals to be processed;

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a channelizing module for Fast Fourier Transform channelizing said plurality of sub-band signals into a respective plurality of complex spectral components;

a processing module for signal processing said plurality of complex spectral components, including a means for determining the presence of at least one signal of interest based on multiple time averaging analysis of said plurality of complex spectral components; and

a high speed data router as means for digitally routing respective plurality of module data between said modules,

wherein said channelizing module includes a plurality of Fast Fourier Transform (FFT) channelizers operatively connected to receive corresponding ones of said plurality of sub-band signals and thereby generate a corresponding plurality of the complex spectral components, and a data router port for outputting said plurality of complex spectral components to said processing module, and

wherein each of said plurality of Fast Fourier Transform (FFT) channelizers includes means for hyperchannelizing the corresponding one of said plurality of sub-band signals into hyperchannelized signals each with a bandwidth at least 30% narrower than a bandwidth of said at least one signal of interest in generating said corresponding complex spectral components.

14. A method according to claim 11, wherein said step of determining the presence of at least one subset of adjacent spectral components includes storing said complex spectral components, conducting spectral filter convolution of said complex spectral components, converting said complex spectral components to real spectral components, and generating spectral activity parameter data on said real spectral components.

17. A method according to claim 14, wherein said step of generating spectral parameter data includes generating spectral magnitude running averages and delayed running averages on said real spectral components.

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19.   A method according to claim 17, wherein said step of Fast Fourier Transform (FFT) [processing] <u>channelizing processes</u> said plurality of sub-band signals via a corresponding plurality of FFT channels [includes] <u>including</u> hyperchannelizing said plurality of sub-band signals so as to generate complex spectral components with bandwidths narrower than a signal-of-interest bandwidth.

28.   A method for demodulating and recognizing a complex spectral signal of interest, comprising the steps of:

       accessing said complex spectral signal to be processed stored in a buffer memory;

       synthesis filtering of said complex spectral signal so as to generate <u>a</u> complex time domain [data] <u>signal</u> based on said complex spectral signal;

       demodulating said [synthesis filtered and] <u>complex</u> time domain [converted] signal;

       conducting further processing of said demodulated signal to determine further signal parameters;

       comparing said signal parameters to one or more predetermined signals of interest parameters and computing a weighted score based on parameter matches from said comparing; and

       thresholding said score of said parameter matches between said one or more predetermined signal parameters and said demodulated signal parameters, and outputting respective signal of interest scores above threshold as indication of signal of interest recognition.

36.   A system for direction finding of a signal, comprising:

       a plurality of wideband receivers for receiving input data from a plurality of wideband sensor sources, each of said receivers having a corresponding sensor or antenna source spatially separated from the corresponding sensors or antennas of other receivers;

       a sub-band decimation module for each respective receiver, for decimating the plurality of wideband sensor sources into a plurality of sub-band data streams to be processed;

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a channelizing module for Fast Fourier Transform channelizing said plurality of sub-band data streams from said plurality of sensor sources into a respective plurality of complex spectral component streams;

a processing module for signal processing said first sensor source plurality of complex spectral component streams, including a means for determining the presence of at least one signal of interest based on multiple spectral magnitude running averages and analysis of said plurality of complex spectral component streams;

a direction finding module for determining an angle-of-arrival of the at least one signal of interest based on the analysis of said processing module and said sensor source plurality of complex spectral component streams; and

a high speed data router for digitally routing respective data between said sub-band decimation, channelizing, processing and direction finding modules.

39. A system according to claim 36, wherein said plurality of complex data streams [data] output from [sub-band data stream and FFT channelizers] the channelizing module are operatively connected to subsequent [processing] modules by a high speed data router [for connecting said plurality of complex data streams to said processing modules].

55. A method according to claim [51] 49, wherein said step of FFT processing said plurality of sub-band signals includes hyperchannelizing said plurality of sub-band signals so as to generate a plurality of complex spectral component streams with bandwidths narrower than a signal-of-interest bandwidth.

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